

SAP HANA Platform SPS 09
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Red Hat Enterprise Linux (RHEL) 6.5 Configuration Guide for SAP HANA

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1 How to Use This Document

This guide is divided into three main parts:

1. Manual installation of a RHEL host with SAP HANA
2. Installation with a kickstart file
3. Appendixes that provide shortcuts to more detailed information

Read the entire chapter first, and then follow the instructions. Some steps depend to a large extent on your environment and the devices used in your servers. In this case, we can only instruct you what to do, but not how.

Unless stated otherwise, the sections in the first two chapters are interdependent. If you skip a step, make sure that the action described is really not important for your installation.

The step-by-step instructions always contain a short description stating what has to be done. Below the text there is a gray box with an example of what you can do. Only use copy and paste if you are sure that you do not have to replace a placeholder.

The setup described in this document is based on the recommendations in SAP Note 2013638, SAP Note 2001528, and SAP Note 1658845.

Related Information

[SAP Note 2013638 - SAP HANA DB: Recommended OS settings for RHEL 6.5](#) 

[SAP Note 2001528 - Linux: SAP HANA Database SPS 08 revision 80 \(or higher\) on RHEL 6 or SLES 11](#) 

[SAP Note 1658845 - Recently certified SAP HANA hardware/OS not recognized](#) 

2 Install SAP HANA Manually on RHEL for SAP HANA

A manual SAP HANA installation on RHEL for SAP HANA needs to be prepared.

2.1 Synonyms for Different Hosts

The following host names have to be substituted with the corresponding host names in your environment:

- Mandatory hosts
They need to be accessible, as the installation fails without them
 - Host to install: **<hostname>.example.com**
 - Without using a RHN Satellite Server
 - Webserver for kickstart files: **<webserver>.example.com**
 - FTP for repositories: **<ftpserver>.example.com**
 - When using a Red Hat Satellite Server:
Example Satellite Server: **satellite.example.com**
 - SAP Service Marketplace
- Strongly advised hosts
These hosts should be accessible, but the installation will still work if you do not have one of them
 - NTP server: **ntp.example.com**

In this example, both the web server and the ftp server are represented by the machine **hanasrv.example.com**.

2.2 Prepare the Host

The following preparations must be made.

- Install RHEL for SAP HANA
 - Interactively from DVD (use the minimal installation)
 - Set the host name, for example to **<hostname>.example.com**
 - Add the ntp server, for example **ntp.example.com**
 - Check for network connectivity.
 - Register the host to the Red Hat Customer Portal or your local Red Hat Satellite server and subscribe it to the “RHEL for SAP HANA 6.5” channel.
 - Install the g++ 4.7 compatibility layer, package name: **compat-sap-c++**
 - If you plan to use XFS for some of the file systems, the server also needs to be subscribed to the RHEL Server Scalable File System channel.

- Check the availability of the NTP server

```
# service ntpd stop
# ntpdate ntp.example.com
# service ntpd start
```

- Check if the NTP service is enabled

```
# chkconfig | grep ntpd
ntpd 0:off 1:off 2:on 3:on 4:on 5:on 6:off
ntpdate 0:off 1:off 2:off 3:off 4:off 5:off 6:off
```

- If not, enable the NTP service

```
# chkconfig ntpd on
```

- The ntpdate service script adjusts the time according to the NTP server every time when the system starts. This happens before the regular NTP service is started, and ensures an exact system time even if the time deviation is too great to be compensated by the NTP service.

```
# echo ntp.example.com >> /etc/ntp/step-tickers
# chkconfig ntpdate on
```

- Update only the OS kernel and firmware packages to the latest release that appeared in RHEL 6.5. According to *SAP Note 2013638 - SAP HANA DB: Recommended OS settings for RHEL 6.5* the system must not be updated to RHEL 6.6. SAP HANA is currently certified for RHEL 6.5 only.

- To lock the kernel version to the last available kernel of the 2.6.32-431 series you need the `yum-{versionlock,security}` plugins:

```
# yum -y install yum-versionlock yum-security
```

- Take a look at the last versions of the following packages that belong to the RHEL6.5 stream:

```
# yum --showduplicates list nss-softokn # <= 3.14.3-12.el6_5
# yum --showduplicates list nss-softokn-freebl # <= 3.14.3-12.el6_5
# yum --showduplicates list kernel # <= 2.6.32-431.29.2.el6
# yum --showduplicates list kernel-headers # <= 2.6.32-431.29.2.el6
# yum --showduplicates list kernel-firmware # <= 2.6.32-431.29.2.el6
```

- Configure the plugin with adding the appropriate entries in `/etc/yum/pluginconf.d/versionlock.list`:

```
kernel-2.6.32-431.29.2.el6.*
kernel-firmware-2.6.32-431.29.2.el6.*
kernel-headers-2.6.32-431.29.2.el6.*
nss-softokn-freebl-3.14.3-12.el6_5.*
nss-softokn-3.14.3-12.el6_5.*
```

- Check which updates can be installed now. Make sure that the packages enumerated above are not updated to a higher version than specified.

```
# yum --security check-update | less
```

- Apply the security updates. Typically, the kernel is updated as well.

```
# yum --security update
```

The configuration file `/boot/grub/grub.conf` is modified automatically so that the new kernel will be the default one at boot time.

- The firmware package should be in sync with the kernel revision. If it is not installed, Install it with:

```
# yum -y update kernel kernel-firmware
```

- Now you can erase the old kernel.
 - Reboot the machine and use the new kernel:

```
# reboot
```

- The old kernel can be erased with:

```
# package-cleanup --oldkernels --count=1 -y
```

- For technical details on updating RHEL 6.5 for SAP HANA please refer also to:
 - Red Hat Enterprise Linux for SAP HANA: system updates and supportability
<https://access.redhat.com/solutions/1243453>
 - Why can I not install or start SAP HANA after a system upgrade?
<https://access.redhat.com/solutions/1236813>

- Install the **base** package group and xfs tools:

```
yum -y groupinstall base
yum -y install xfsprogs
```

- Create local storage for SAP HANA.

- Check for empty devices

```
# lsblk -f
NAME FSTYPE LABEL UUID MOUNTPOINT
sda
├─sda1 /boot
└─sda2
sdb
```

- Create a disk partition.
 - Let us assume that disk /dev/sdb is our free device
 - If you have less than 2 TB free space on the disk, use fdisk

```
# fdisk -cu /dev/sdb
Command (m for help):c
```

- If you have 2 TB or more free space, use parted and the GPTlabel

```
# parted /dev/sdb
```

- Create PV with `pvccreate /dev/<disk-partition>`
- Expand VG with `vgextend vg00 /dev/<disk-partition>`
- Check with `pvs` and `vgs`

- Create logical volumes for the SAP HANA instance according to your sizing. This is an example for the logical volumes you could create for a host with 96 GiB of memory:

```
# lvcreate -L96G -n lv_hana_shared vg00
# lvcreate -L288G -n lv_hana_data vg00
# lvcreate -L96G -n lv_hana_log vg00
# lvcreate -L50G -n lv_usr_sap vg00
```

For more information about sizing SAP HANA, see *Appendix F - Table to Calculate the Size of the Logical Volumes* in this document and *Sizing SAP HANA* in the *SAP HANA Master Guide*.

- Create mount points

```
# mkdir -p /hana/{shared,data,log}
# mkdir -p /usr/sap
```

- On these Logical Volumes, create four file systems based on xfs. For more information about creating and tuning XFS file systems, have a look at the manpage of the mkfs.xfs executable.

- XFS is a good file system for large files or for extremely small files.

One disadvantage is the lack of tuning support once you have created the file system. This means that you have to tune the file system while creating it. The only way you can tune it subsequently is by creating it all over again.

In the example below, the file system resides at a RAID 5 Array with 3 disks, a file system block size of 4 KB and a chunk size of 64 KB.

```
# mkfs -t xfs -b size=4096-d su=64k,sw=2 /dev/vg00/lv_hana_shared
# mkfs -t xfs -b size=4096-d su=64k,sw=2 /dev/vg00/lv_hana_data
# mkfs -t xfs -b size=4096-d su=64k,sw=2 /dev/vg00/lv_hana_log
# mkfs -t xfs -b size=4096-d su=64k,sw=2 /dev/vg00/lv_usr_sap
```

- To find out how to achieve optimum performance of the XFS file system, see <https://access.redhat.com/labs/fslayoutcalculator>

- Write the mount directives to /etc/fstab

```
# echo "/dev/vg00/lv_hana_shared /hana/shared xfs defaults 1 3" \
>> /etc/fstab
# echo "/dev/vg00/lv_hana_data /hana/data xfs defaults 1 4" \
>> /etc/fstab
# echo "/dev/vg00/lv_hana_log /hana/log xfs defaults 1 5" \
>> /etc/fstab
# echo "/dev/vg00/lv_usr_sap /usr/sap xfs defaults 1 6" \
>> /etc/fstab
```

- Check if xfs file systems from /etc/fstab can be mounted

```
# mount -avt xfs
```

- Install dependencies in accordance with the *SAP HANA Server Installation and Update Guide* and the numactl package if the benchmark HWCCT is to be used

```
# yum install gtk2 libicu xulrunner ntp sudo tcsh libssh2 \
expect cairo graphviz iptraf krb5-workstation krb5-libs.i686 \
nfs-utils lm sensors rsyslog compat-sap-c++ openssl098e openssl \
PackageKit-gtk-module libcanberra-gtk2 libtool-ltdl xauth \
compat-libstdc++-33 numactl
```

- Install the SAP Java Virtual Machine
 - Download it from SAP Service Marketplace.
 - As an alternative, you can use IcedTea.

```
# yum -y install icedtea-web
```

- Disable SELinux in /etc/sysconfig/selinux

```
# sed -i 's/^SELINUX=enforcing/SELINUX=disabled/g' /etc/sysconfig/selinux
# sed -i 's/^SELINUX=permissive/SELINUX=disabled/g' /etc/sysconfig/selinux
```

- If kdump should be disabled, switch it off

```
# service kdump stop
```

```
# chkconfig kdump off
```

If it should be enabled for support purposes, keep it enabled. Any settings can be made in `/etc/sysconfig/kdump`. Restart it to apply the new settings.

- Install and configure the package `tuned-profiles-sap-hana` from the *RHEL for SAP HANA* channel:

```
# yum -y install tuned-profiles-sap-hana
```

- Configure the profile as follows
 - For SAP HANA operating on bare-metal:

```
# tuned-adm profile sap-hana
```

- For SAP HANA operating in a virtual machine on a VMware hypervisor:

```
# tuned-adm profile sap-hana-vmware
```

- The following parameters have to be set in `/etc/sysctl.conf`. The SAP HANA installer adds some of them, so they should be set after SAP HANA is installed.

The following is an example:

```
net.ipv4.tcp_slow_start_after_idle=0
net.ipv4.conf.all.rp_filter=0
net.ipv4.ip_local_port_range=40000 61000
net.ipv4.neigh.default.gc_thresh1=256
net.ipv4.neigh.default.gc_thresh2=1024
net.ipv4.neigh.default.gc_thresh3=4096
net.ipv6.neigh.default.gc_thresh1=256
net.ipv6.neigh.default.gc_thresh2=1024
net.ipv6.neigh.default.gc_thresh3=4096
kernel.shmmax=137438953472
kernel.shmall=33554432
kernel.shmmni=65536
kernel.msgmni=32768
kernel.sysrq=1
vm.swappiness=60
vm.max_map_count=2000000
vm.memory_failure_early_kill=1
fs.file-max=20000000
fs.aio-max-nr=458752
```

- For compatibility reasons, four symbolic links are required:

```
# ln -s /usr/lib64/libssl.so.0.9.8e /usr/lib64/libssl.so.0.9.8
# ln -s /usr/lib64/libssl.so.1.0.1e /usr/lib64/libssl.so.1.0.1
# ln -s /usr/lib64/libcrypto.so.0.9.8e /usr/lib64/libcrypto.so.0.9.8
# ln -s /usr/lib64/libcrypto.so.1.0.1e /usr/lib64/libcrypto.so.1.0.1
```

- Because SAP HANA can crash occasionally when Transparent Huge Pages are enabled, they should be deactivated until verification. In the `/boot/grub/grub.conf` file, add the kernel command line argument:

```
transparent_hugepage=never
```

- Transparent Huge Pages can be switched on and off online with:

```
# echo always > /sys/kernel/mm/transparent_hugepage/enabled
# echo never > /sys/kernel/mm/transparent_hugepage/enabled
```

- Use a tuned profile to minimize latencies:

```
# yum -y install tuned
```



```
# tuned-adm profile latency-performance
# chkconfig tuned on
# service tuned start
```

- For hardware with 8 IvyTown sockets and larger, the maximum number of processes for the `sap` group is not sufficient. This causes the installation of SAP HANA to fail. The solution is to create the `/etc/security/limits.d/99-sap.conf` file:

```
@sap soft nproc unlimited
```

By default, RHEL for SAP HANA is configured in such a way as to prevent "fork bombs". The fact that the group `sap` can now create an unlimited number of processes can be a potential security issue.

- The occurrence of SAP HANA crashes is entirely unrelated to operating system mechanisms. We can therefore omit the application crash and core file handling of the operating system.
 - The `abrt` service which handles application crashes needs to be disabled completely.

```
# chkconfig abrt off
# chkconfig abrt-ccpp off
# service abrt stop
# service abrt-ccpp stop
```

- The same applies with core file creation. To disable core dumps for all users, open `/etc/security/limits.conf`, and add the following line:

```
* soft core 0
* hard core 0
```

Related Information

[SAP Note 2013638 - SAP HANA DB: Recommended OS settings for RHEL 6.5](#) 

[SAP HANA Master Guide](#)

[Appendix F - Table to Calculate the Size of the Logical Volumes \[page 23\]](#)

3 SAP HANA Installation

On the following pages, the steps to install SAP HANA are explained in detail.

Please substitute the parameters shown in <square brackets>. The installation is straightforward, but please read the *SAP HANA Server Installation and Update Guide* before you begin.

3.1 Prerequisites

Below you can find the prerequisites which must be met before you can install the SAP HANA system.

The official SAP HANA packages can be downloaded from the SAP Service Marketplace. It comes in two archives which cannot be extracted separately. As of time of writing, these were downloaded to `/tmp/IMDBSERVER10081_0-10009569_P{1,2}.tar`. According to the SAP Note 2023163 extract them with

```
# cd /tmp
# tar -xvM --file=IMDBSERVER10081_0-10009569_P1.tar \
--file=IMDBSERVER10081_0-10009569_P2.tar
```

Related Information

[SAP Note 2023163 - Downloading multispanning TAR archives](#) 

3.1.1 System

The table below shows information about the system SAP HANA is installed on.

Table 1:

Object	Task	Remark
Logical volume	Create 128 GB logical volume	Space to store the SAP HANA installer temporarily

3.1.2 SAP HANA

The table below shows information about SAP HANA.

Table 2:

Object	Task	Remark
SAP archiver	Download from SAP Service Market-place	Only use the latest version
SAP HANA installer	Download from SAP Service Market-place	Only use the latest version
Installer path	Previously created logical volume	Space required for installer
Data path	Previously created logical volume	Space to install SAP HANA
Log path	Previously created logical volume	Space to store log information
SAP HANA system ID	ID to identify the SAP HANA database	Has to be identical for all instances running in a clustered environment
Instance number	Identification number for a SAP HANA instance running on a host	Has to be unique in a clustered environment or if multiple instances running on the same host
System usage	Specify the application area of the installed instance	
SAP HANA administrator data	UNIX user information for the SAP HANA administration user	Usual information found in /etc/passwd (uid, gid, home directory and path to a shell)
Passwords	Passwords for different users	See Appendix D for a list of passwords to use and their functions

3.2 Install an SAP HANA System

The SAP HANA lifecycle management tools install or update the underlying components of the SAP HANA platform.

An SAP HANA system can be installed or updated from the command line interface (hdbclm) or from the graphical user interface (hdbclmgui). Using the SAP HANA hdbclm and hdbclmgui tools, SAP HANA components can be installed, updated, or uninstalled independently of each other. It is possible to perform installation and update tasks in interactive mode or batch mode.

For a detailed description of the installation of an SAP HANA system, see *SAP HANA Server Installation and Update Guide*.

Related Information

[SAP HANA Server Installation and Update Guide](#)

3.2.1 Install SAP HANA Interactively Using hdbicm

In this chapter, we install an SAP HANA instance on the system.

You have to make sure that the system itself is installed as described in the “Preparation of the host” section, and that all preconditions from the tables above are met.

Unless stated otherwise, the name of the volume groups, users and paths are examples that can be replaced to meet the needs of the OEM.

- Create temporary space for the SAP HANA installer

Assumed values

- LV name: **lv_install**
- LV VG: **vg00**
- LV size: 128 GB
- LV mount point: **/install**

```
# lvcreate -l128G -n lv_install vg00
# mkfs -t xfs /dev/vg00/lv_install
# mount /dev/vg00/lv_install /install
```

- Copy the SAP archiver to the personal “~/bin” directory of the root user. The current SAP archiver name is SAPCAR_5-20002089.exe. The numbers indicate the version of the archiver. These change for newer versions.

```
# cp <Path to downloaded installer>/SAPCAR_315-20010450 ~/bin
```

- Extract the SAP HANA installer. At the time of writing, the current installer name is IMDB_SERVER100_81_0.SAR. The numbers indicate the version of the installer. These change for newer versions.

```
# cd /install
# SAPCAR_5-20002089.exe -xvsf <Path to archive>/ \
IMDB_SERVER100_81_0.SAR
```

Copy the complete directory to your local machine.

- Check the creation of the installation directory. The files are unpacked in a directory named SAP_HANA_DATABASE.

```
# ls -d SAP_HANA_DATABASE
```

- Install the SAP HANA database software.
Switch to the installer sub directory.

```
# cd SAP_HANA_DATABASE
```

- Set a symbolic link for the cryptographic library (For technical reasons, the SAP HANA database is directly linked to a specific version of the library. Red Hat has a specific sub-version of the library installed, so you have to create a link)

```
# ln -s /usr/lib64/libssl.so.1.0.1e /usr/lib64/libssl.so.1.0.1
# ldconfig
```

- **i Note**

If you are using the official SAP HANA SPS 08 installation archive from the SAP Service Marketplace, you need to replace the `HanaHWCheck.py` file as described in SAP Note 1658845, so that the SAP HANA installer can recognize Red Hat Enterprise Linux 6.5 as a valid operating system. In revisions higher than 80 this problem does not occur.

Launch the installer.

```
# ./hdblcm --action=install
```

Make sure that you have the following data available:

- System ID of the database
- Instance number of the installation (beware of cluster installations)
- Usage type of the database
- Instance admin password
- Linux account data of the instance admin
 - Home directory
 - UID
 - Default shell
 - GID
- System user password
- Decide if the SAP HANA instance should be restarted after machine reboot.
- The name of the log file is displayed at the end of the installation:
 - Check the log file if you find any errors
 - Log in with the user of the operating system administrator, in this example as follows:

```
# su - anaadm
```

- Check whether the database has started

```
[anaadm@testhanar ~]$ ./HDB info
```

- Test the database start-up

```
[anaadm@testhanar ~]$ ./HDB start || ./HDB stop
```

For a detailed description of how to install an SAP HANA system, see *SAP HANA Server Installation and Update Guide*.

Related Information

[SAP HANA Server Installation and Update Guide](#)

[SAP Note 1658845 - Recently certified SAP HANA hardware/OS not recognized](#)

3.2.2 Install SAP HANA Interactively Using hdblcgui

You can install an SAP HANA system from a graphical interface by running the SAP HANA lifecycle management tool `hdblcgui`.

This tool is available as an interactive tool for GNOME and as a command line tool (`hdblc`) to be used in a kickstart session. To install the database, first set the relevant permissions on the installation directories with

```
# chmod o+rx /sapmnt/data
# chmod o+rx /sapmnt/log
```

i Note

If you are using the official SAP HANA SPS 08 installation archive from the SAP Service Marketplace, you need to replace the `HanaHWCheck.py` file as described in SAP Note 1658845, so that the SAP HANA installer can recognize Red Hat Enterprise Linux 6.5 as a valid operating system. In revisions higher than 80 this problem does not occur.

Switch to the installation directory and launch the installer with

```
# LD_PRELOAD=/opt/rh/SAP/lib64/compat-sap-c++.so ./hdblcgui
```

For a detailed description of how to install an SAP HANA system, see *SAP HANA Server Installation and Update Guide*.

Related Information

[SAP HANA Server Installation and Update Guide](#)

[SAP Note 1658845 - Recently certified SAP HANA hardware/OS not recognized](#)

3.2.3 Install in Batch Mode Using hdblc

The SAP HANA lifecycle management tool `hdblc` can also be used as a command line tool for installation in batch mode.

The *SAP HANA Server Installation and Update Guide* explains the process in detail. In our case, we use the following command line:

```
# LD_PRELOAD=/opt/rh/SAP/lib64/compat-sap-c++.so \
# cat /root/password.xml | "<installation medium>/DATA_UNITS/
HDB_LCM_LINUX_X86_64/hdblc \
--read_password_from_stdin=xml --sid=ANA --number=00 \
--sapmnt=/sapmnt/shared --datapath=/sapmnt/data \
--logpath=/sapmnt/log --shell=/bin/bash --hostname=$(hostname) \
-b --system_usage=test --autostart=1 --components=server \
--system_usage=test -timezone=CET --max_mem=827052 [--db_mode=single_container]
```

In this example, SAP HANA is installed the same way as the one installed graphically. We can now use this command line in a kickstart or scripted environment. As a new feature in SPS09, the optional parameter in

square brackets is used to install a Multi-tenant database holding multiple containers. By default, a single-container database will be installed. For a complete guide to all parameters, see the *SAP HANA Server Installation and Update Guide*.

i Note

If you are using the official SAP HANA SPS 08 installation archive from the SAP Service Marketplace, you need to replace the `HanaHWCheck.py` file as described in SAP Note 1658845, so that the SAP HANA installer can recognize Red Hat Enterprise Linux 6.5 as a valid operating system. In revisions higher than 80 this problem does not occur.

Related Information

[SAP HANA Server Installation and Update Guide](#)

[SAP Note 1658845 - Recently certified SAP HANA hardware/OS not recognized](#) 📄

3.3 Firewall Configuration for RHEL for SAP HANA 6.5

The firewall is disabled by default. Please see Appendix I for detailed instructions on how to configure iptables for usage with SAP HANA.

3.4 Install in a Clustered Environment

To install SAP HANA in a clustered environment, make sure that you have a unique database instance number for each SAP HANA instance available. Another recommendation is the setup of the firewall on both machines.

3.5 Install Using a Kickstart File

For automatic installation via the network, you can use the kickstart file provided.

If you do not have a PXE environment to pass the required network information to the kernel, you will need to specify the kickstart file manually on the kernel command line.

- Insert the boot DVD
- When the boot menu from the DVD appears, select Update or install ...
- Press the <TAB> - key
You now see the Kernel Command line

- Add the following parameters:
 - **ksdevice**=<Ethernet interface or **link**>, for example
 - **ksdevice=link** (for the first network device with a link)
 - **ksdevice=eth3**
 - **ks**=<method and URL to the kickstart file>, for example
 - **ks=https://192.168.0.200/kickstart.php?instance=01&sid=RHT**
 - **ks=http://192.168.0.200/hana.cfg**
 - **ip**=<IP Address>, for example
ip=192.168.0.101
 - **netmask**=<Netmask>, for example
netmask=255.255.255.0
 - **gateway**=<Gateway address>, for example
gateway=192.168.0.1
- Installation of RHEL and SAP HANA should run automatically until you are prompted to accept the SAP HANA EULA (End User License Agreement).

3.6 Description of the Kickstart File for RHEL for SAP HANA

The following pages provide a brief description of the kickstart file provided as a sample for the SAP HANA hardware partners.

- The upper part of the file contains the partition scheme, using xfs for the logical volumes dedicated for SAP HANA.
- A number of additional repositories and packages need to be included for the installation of SAP HANA, as well as for the kernel modules supplied by IBM (see comments in the file).
In order to keep the footprint as small as possible, only the base package group will be installed.
- The **%pre** section comprises a small routine for presenting the EULA to the customer.
 - If the customer accepts this, the OS and application are installed
 - If s/he rejects, the installation process is aborted immediately, and the machine is rebooted
 - Feel free to add more vendor-specific dialogs or settings to additional **%pre** sections. There can be as many additional sections as you want. These are all executed serially before the installation begins.
 - The second **%pre** script calculates the size of the logical volumes reserved for SAP HANA according to the requirements of SAP HANA. It writes an include file to `/tmp`, which in turn is included in the install section for partitioning.
- The **%post** section includes the following:
 - Firstly, all necessary services are enabled, and all others disabled.
 - New software repositories are written to enable the installation of additional products later on. The `SERVER` variable needs to be modified by the OEM.
 - The IPv6 protocol is disabled by executing `/bin/true` whenever the kernel tries to load the appropriate module.
 - Create the `/etc/resolv.conf` file. The variables `DOMAIN`, `DNS1` and `DNS2` need to be modified by the OEM.

- The network interfaces and the udev numbering are defined. If the kickstart process uses DHCP/PXE, the network parameters used here must be the ones used later on. All parameters must be set by the OEM.

Avoid network directives using fixed IP on the kernel command line when using DHCP/PXE.

- Set the host name. In a real environment, this could also be obtained using DNS/BIND. The SAP HANA installer expects the short version of the hostname without the domain (no FQDN).
- Modify the file `/etc/hosts`. This is crucial for the SAP HANA installer to work. It is up to the OEM to set the array index of IPADDR properly here.
- Because a proper time synchronization is crucial for SAP HANA to work, NTP is configured. The clock is synchronized initially in order to avoid clock skew when the service is started. The OEM must choose the right NTP server here.
- Set a symbolic link in `/usr/lib64` from the latest version of libssl. This is a prerequisite for the version of SAP HANA tested as by 20/03/2014.
- Install the database in the unattended mode
 - First, a tarball and the `password.xml` file must be copied to the local machine. The `SERVER` variable holds the IP address of the machine that the file comes from and must be modified by the OEM.
 - The command line for the installation of SAP HANA in batch mode is as follows:

```
# LD_PRELOAD=/opt/rh/SAP/lib64/compat-sap-c++.so \
# cat /root/password.xml | "<installation medium>/DATA_UNITS/
HDB_LCM_LINUX_X86_64/hdblcm \
--read_password_from_stdin=xml --sid=ANA --number=00 \
--sapmnt=/hana/shared --datapath=/hana/data --logpath=/hana/log \
--shell=/bin/bash --hostname=$(hostname) -b \
--system_usage=test --autostart=1 --components=server \
--system_usage=test --timezone=CET --max_mem=827052
```

- The instance (`--sid` option) must be changed by the OEM to meet the needs of the customer.
- The parameter `--max_mem` limits the overall memory usage of SAP HANA.
- For an explanation of the various options, please go to the installation directory and refer to

```
# ./hdblcm --action=install --help
```

- The same applies for the `password.xml` file containing the admin passwords (see below).
- You can ignore the checks performed by the SAP HANA installer (for installation on virtual systems for example) by appending ignore statements to the previous line
 - `--ignore=check_hardware`
 - `--ignore=check_min_mem`
- As explained above, the installer can be provisioned with a password file. The following is an example of the password file in XML syntax:

```
<?xml version="1.0" encoding="UTF-8"?>
<Passwords>
<password>Adm1234</password>
<sapadm_password>Agent1234</sapadm_password>
<system_user_password>Sys1234</system_user_password>
<root_password>Root1234</root_password>
</Passwords>
```

If the product is installed using kickstart, the following variables are set in `/etc/sysctl.conf`:

Table 3:

Parameter	RHEL for SAP HANA	Remarks
<code>net.ipv4.tcp_slow_start_after_idle</code>	1	Default for RHEL*
<code>net.ipv4.conf.all.rp_filter</code>	0	Default for RHEL
<code>net.ipv4.ip_local_port_range</code>	40000 65300	Set by installer*
<code>net.ipv4.neigh.default.gc_thresh{1,2,3}</code>	{128,512,1024}	Default for RHEL**
<code>net.ipv6.neigh.default.gc_thresh{1,2,3}</code>	{128,512,1024}	Default for RHEL**
<code>kernel.shmmax</code>	68719476736	Default for RHEL**
<code>kernel.shmall</code>	4294967296	Default for RHEL**
<code>kernel.shmmni</code>	524288	Set by installer*
<code>kernel.msgmni</code>	32768	Default for RHEL**
<code>kernel.sem</code>	1250 256000 100 8192	Set by kickstart
<code>vm.max_map_count</code>	92500000	Set by installer*
<code>vm.memory_failure_early_kill</code>	1	Set by installer*
<code>fs.file-max</code>	20000000	Set by installer*
<code>fs.aio-max-nr</code>	131072	Set by installer*

* = see SAP HANA documentation

** = if set lower, the values must be increased to the ones above

The kickstart file inserts the following kernel parameter during `%post`: `kernel.sem`.

3.7 The Kickstart Process

The kickstart process can be initiated using PXE or with a physical or virtual DVD. When the system boots, the user sees a selection of options. The first option **Install or upgrade an existing system** is highlighted by default.



- Depending on the hardware manufacturer and your country, set your keyboard to the appropriate mapping so that you can access certain special characters more easily. You do this in the main menu, under **Keyboard**. If you do not do this, the = character cannot be accessed.
- Leave this menu item selected and press <TAB>.
- You now have to enter a number of kernel command line parameters.
 - **ks=http://<install server>/hana.cfg**
 - **ksdevice=<HANA network interface>**
 - **ip=<HANA network address>**
 - **netmask=<HANA netmask>**
 - **gateway=<HANA gateway>**
- As mentioned above, these parameters must be equal to the ones defined persistently for the SAP HANA interface defined in the kickstart file in the post-installation section, Part 1.

4 Appendix

The appendix provides additional information.

4.1 Appendix A - Networking Ports

The table below shows the TCP/IP ports used in the SAP HANA environment. The firewall is not yet part of the kickstart mechanism and will be added later on request. The placeholder "xx" must be replaced with the SAP HANA instance number.

Table 4:

Schema	Description
3xx09	Administration Port for SAP HANA
1128 – 1129 5xx13 - 5xx14	SAP HANA Studio
43xx 80xx	Company Network
3xx15 3xx17	SAP HANA Studio + Replication
3xx01 3xx07	Primary Site for Clustering

4.2 Appendix B – Dependencies for RHEL for SAP HANA

The following packages have to be installed on RHEL for SAP HANA as a dependency for SAP HANA. Without these packages, the installation is likely to fail.

These packages are in the usual "RHEL for SAP HANA" channels for the base installation:

- gtk2
- libicu
- xulrunner
- ntp
- sudo

- tcsh
- libssh2
- expect
- cairo
- graphviz
- iptraf
- krb5-workstation
- krb5-libs.i686
- nfs-utils
- lm_sensors
- rsyslog
- openssl098e
- openssl
- xauth
- PackageKit-gtk-module
- libcanberra-gtk2
- libtool-ltdl
- gcc
- glib
- glib-devel
- glibc
- glibc-devel
- zlib-devel
- libstdc++-devel
- kernel-devel
- rpm-build
- redhat-rpm-config
- numactl
- iperf

Additionally, the packages `iperf` and `numactl` must be installed if the benchmark HWCCT is intended to be used. The `iperf` package can be obtained from the EPEL repository:

```
# rpm -Uvh http://ftp.uni-kl.de/pub/linux/fedora-epel/6/x86_64\
/epel-release-6-8.noarch.rpm
# yum -y install iperf
```

Because this package is in the SAP HANA specific channel, so you can download it over RHN from that channel. It should be at least version 4.7.2-10:

- `compat-sap-c++`

The last package has to be downloaded from the SAP Service Marketplace, and must be installed in a separate step.

- SAP-JVM for RHEL for SAP HANA 6.5

4.3 Appendix C – Additional Packages for SAP HANA Support

The following program is used for SAP support. It is usually not shipped on a DVD/Channel for the plain RHEL 6.x installation.

This program has to be downloaded from the SAP Service Marketplace:

- niping

See the table below for details of what these programs are used for.

Table 5:

Name	Description
niping	SAP tool used for testing the network

4.4 Appendix D – The XML Password File

Below you can find an example password file for the SAP HANA installation. All the passwords are written in plain text in this file.

Observe the following security recommendations:

- Set the access permission of the file as restrictively as possible
- Remove the file immediately after it is no longer used (by default this is performed automatically by kickstart)
- If a password file is used in a kickstart file, acquire the file over a secure transmission path

```
<?xml version="1.0" encoding="UTF-8"?>
<Passwords>
<password>Adm1234</password>
<sapadm_password>Agent1234</sapadm_password>
<system_user_password>Sys1234</system_user_password>
<root_password>Root1234</root_password>
</Passwords>
```

The table below explains which user the password is set for, and what function the user has. Replace the `<sid>` with the one you entered during installation.

Table 6:

Keyword	User name	Remark
password	<sid>adm	Operating system administrator
sapadm_password	sapadm	SAP host agent user
system_user_password	SYSTEM	Administrative user for SAP Database
root_password	root	Linux root user

4.5 Appendix E – Tunable Kernel Parameters

The following tunable kernel parameter should be set in `/etc/sysctl.conf` in order to optimize the performance of the database.

Table 7:

Parameter	RHEL 6.5
<code>net.ipv4.tcp_slow_start_after_idle</code>	0
<code>net.ipv4.conf.all.rp_filter</code>	0
<code>net.ipv4.ip_local_port_range</code>	40000 61000
<code>net.ipv4.neigh.default.gc_thresh{1,2,3}</code>	{256,1024,4096}
<code>net.ipv6.neigh.default.gc_thresh{1,2,3}</code>	{256,1024,4096}
<code>kernel.shmmax</code>	137438953472*
<code>kernel.shmall</code>	33554432*
<code>kernel.shmmni</code>	65536*
<code>kernel.msgmni</code>	32768
<code>kernel.sem</code>	1250 256000 100 8192
<code>kernel.msgmax</code>	65536
<code>kernel.sysrq</code>	1
<code>vm.swappiness</code>	60
<code>vm.max_map_count</code>	2000000
<code>vm.memory_failure_early_kill</code>	1
<code>fs.file-max</code>	20000000
<code>fs.aio-max-nr</code>	458752

The values marked with an asterisk (*) will be calculated by the installer in accordance with the size of your available memory. The values are then written to the `sysctl.conf` file.

4.6 Appendix F - Table to Calculate the Size of the Logical Volumes

The following table shows you the storage areas that you will need in order to install SAP HANA.

The mount points are defaults which can be changed during installation. The names of the logical volumes are only suggestions and can be changed without affecting the installation.

The size entries in the tables are an example for the logical volumes:

Table 8:

Logical Volume	Size	Mount Point
lv_hana_shared	System memory	/hana/shared
lv_hana_data	3 * System memory	/hana/data
lv_hana_log	System memory	/hana/log
lv_usr_sap	At least 50 GiB	/usr/sap

Example calculation:

System memory: 96 GiB

- /hana/shared = Size of system memory = 96 GiB
- /hana/data = 3 times the size of system memory = 288 GiB
- /hana/log = Size of system memory = 96 GiB
- /usr/sap = At least 50 GiB = 50 GiB

Please keep in mind that the above sizes are in GiB (2^{30}) and not in GB (10^9). This is important because usually the size of the memory is measured with a base of two, while disk space is usually calculated as a decimal number.

For more information, see *Sizing SAP HANA* in the *SAP HANA Master Guide*.

Related Information

[SAP HANA Master Guide](#)

4.7 Appendix G - Configure a PXE Server

To install the underlying RHEL for SAP HANA, you can set up a PXE environment for automatic installation of the bare metal machine. For the rest of this chapter, we use placeholders to replace the placeholders in brackets with the corresponding values of your environment.

To set up provide a PXE environment, the following packages have to be installed on the server which provides the PXE environment:

- **dhcp**
- **syslinux-tftpboot**
- **tftp-server**
- **syslinux**
- **pykickstart**
- The PXE server has to be inside the IP range of the network used to install the systems. You have to modify the network configuration for this host.

File: /etc/sysconfig/network-scripts/ifcfg-**<network-device>**

```
DEVICE=<network-device>
HWADDR=<MAC address of the card>
IPADDR=<IP of the PXE server>
PREFIX=<Number of bits set to one in your netmask>
ONBOOT=yes
BOOTPROTO=static
```

- Next configure the dhcp server to listen on the correct network interface (only necessary if the server has more than one network card and should only provide the service on a specific card)

File: /etc/sysconfig/dhcpd

```
DHCPDARGS=<network-device>
```

- You then have to provide a minimal setup for the dhcp server. Below you can find an example of this minimal setup. Feel free to vary the ranges, but remember to change the placeholders in brackets to values that suit your environment.

File: /etc/dhcp/dhcpd.conf

```
ddns-update-style none;
authoritative;
subnet <your network> netmask <your netmask> {
    range dynamic-bootp <first address> <last address>;
    option domain-name-servers <IP of DNS server>;
    option domain-name "<your domain>";
    option routers <IP of the default gateway>;
    option broadcast-address <Broadcast IP>;
    default-lease-time 600;
    max-lease-time 7200;
    allow booting;
    allow bootp;
        filename "linux-install/pxelinux.0";
        next-server <IP of the PXE server>;
}
```

Mark the service to be started at boot time, start it up and modify the firewall in accordance with your requirements.

- Start and enable the service

```
# chkconfig dhcpd on
# service dhcpd start
```

- Configure the firewall for the required services

- Modify the firewall
 - Start the graphic firewall configuration

```
# system-config-firewall
```

- Open the ports for

- DNS
- HTTP
- FTP

The conntrack modules for the FTP service are activated automatically if you are using the system config firewall tool

- TFTP
- NFS4

- SSH
- DHCP
- Save your configuration

```
# service iptables save
```

Configure the rest of the required services and initialize the tftp storage to provide the files needed to start up the system.

- Configure TFTP
 - Append to file: /etc/xinetd.d/tftp

```
bind = <192.168.0.100>
```

- Activate tftp

```
# chkconfig tftp on
```

- Restart xinetd

```
# service xinetd restart
```

- Configure PXE
 - Copy PXE base files

```
# mkdir -p /var/lib/tftpboot/linux-install/pxelinux.cfg
# cp /usr/share/syslinux/pxelinux.0 /var/lib/tftpboot/linux-install
# cp /usr/share/syslinux/menu.c32 /var/lib/tftpboot/linux-install
```

- Copy the installation images

```
# cp <RHEL6_ISO>/images/pxeboot/* /var/lib/tftpboot/linux-install
```

- Copy the contents of the RHEL for SAP HANA-ISO to a place which is accessible by **ftp** or **http**
- Create directory for the installation tree

```
# mkdir -p </var/ftp/pub/rhel6/dvd>
```

- Copy DVD contents

```
# rsync -av <RHEL6_ISO>/* </var/ftp/pub/rhel6/dvd>
```

- Create a menu for the PXE boot

File: /var/lib/tftpboot/linux-install/pxelinux.cfg/default

```
timeout 100
default menu.c32
label 1
menu label ^ 1) RHEL 6.5 (SAP HANA Desktop)
kernel vmlinuz
append initrd=initrd.img ks=http://<kickstart.example.com>/hana.cfg
```

Restart the modified services and check the kickstart file.

To make sure everything is working as expected, perform the following steps:

- Check the kickstart files.

- Is the kickstart file in place?

```
# ls /var/www/html/hana.cfg
```

- Are the permissions set correctly?

```
# chmod 644 /var/www/html/hana.cfg
```

- Does the URL point to the PXE installer machine?
- Before partitioning, ensure that the disk is erased entirely. Check the kickstart file if it contains the following keywords in the partitioning section.
 - zerombr
 - clearpart -all
- Make a syntax check of the kickstart file

```
# ksvalidator </var/www/html/hana.cfg>
```

- Restart the **xinetd** service

```
# service xinetd restart
# service dhcpd restart
```

- Enable and start the FTP server and the web server

```
# chkconfig vsftpd on
# chkconfig httpd on
# service vsftpd start
# service httpd start
```

4.8 Appendix H – Sample Kickstart File

In the box below, you can find a sample kickstart file for setting up a SAP HANA compatible system. Remember to replace all occurrences of host names in this file with the corresponding IP addresses or host names in your network.

```
# Kickstart file created for SAP HANA installation
# Written by:
# Date: 28.05.2014
# Version: 0.0
install
cdrom
text
lang en_US.UTF-8
keyboard de-latin1-nodeadkeys
network --onboot yes --device eth0 --bootproto dhcp --noipv6
rootpw --iscrypted $1$fMNgI.fz$w4efvaNMstBUakB9rmV4C/
firewall --disabled
authconfig --enablesshadow --passalgo=sha512
selinux --disabled
# Set the timezone for the installation
timezone --utc Europe/Berlin
bootloader --location=mbr --driveorder=sda --append="crashkernel=auto rhgb quiet"
# The following is the partition information you requested
# Note that any partitions you deleted are not expressed
# here so unless you clear all partitions first, this is
# not guaranteed to work
```

```

zerombr
clearpart --all --drives=sde,sdf,sdg
reboot
# Additional RH SFS and SAP repositories
# 20140430 uncommented SMS
# This usually has to be modified by the OEM
repo --name=sfs --baseurl=ftp://192.168.0.100/pub/repos/sfs/ --cost=1
repo --name=sap --baseurl=ftp://192.168.0.100/pub/rhel6/sap/ --cost=2
# Create LVs and filesystems.
part / --fstype=ext4 --asprimary --size=307200 --ondisk=sde --label=HANA_ROOT
part swap --asprimary --size=51200 --ondisk=sde --label=HANA_SWAP
part /hana/backup --fstype=ext4 --asprimary --size=200 --grow --ondisk=sde --
label=HANA_BACKUP
# this one will be formatted later again since we cannot bring in the needed
format options here
#part /hana/disk --fstype=xfs --asprimary --ondisk=sdf --size=200 --grow --
fsoptions="defaults,sunit=2048,swidth=14336,largeio,swalloc,nobarrier,inode64" --
label=HANA_DISK
part /hana/disk --fstype=xfs --asprimary --ondisk=sdf --size=200 --grow --
fsoptions="defaults,largeio,swalloc,nobarrier,inode64" --label=HANA_DISK
part /hana/log --fstype=xfs --asprimary --ondisk=sdg --size=200 --grow --
fsoptions="defaults,swalloc,nobarrier,inode64" --label=HANA_LOG
# everything else is calculated in the second pre-script according to SAP to
create the logical volumes
# ----- Package Section-----
%packages
@base
# 20140430 additional packages
@console-internet
@basic-desktop
@hardware-monitoring
@internet-browser
@perl-runtime
@graphical-admin-tools
genisoimage
screen
gedit
gnome-utils
tigervnc-server
# Additional packages required by SAP HANA
gtk2
libc_u
xulrunner
ntp
sudo
tcsh
libssh2
rsyslog
expect
cairo
graphviz
iptraf
krb5-workstation
krb5-libs.i686
nfs-utils
lm_sensors
libtool-ltdl
xauth
compat-libstdc++-33
# This is needed for hdblcgui
PackageKit-gtk-module
libcanberra-gtk2
# This part is required for the compilation of kernel modules required by the OEM
gcc
kernel-headers
libtool-ltdl
# Additional package xfsprogs from the SFS repository
xfsprogs

```

```

# Additional packages from the SAP repository
cpufrequtils
compat-sap-c++
unixODBC
# ***** Post-Installation 1: Modify grub.conf, install grub and custom xfs
format for HANA_DISK *****
%post --interpreter /bin/bash
# Part 1: Modify grub.conf
sed -i 's/splashimage=(hd1,0)/splashimage=(hd0,0)/g' /boot/grub/grub.conf
sed -i 's/root (hd1,0)/root (hd0,0)/g' /boot/grub/grub.conf
# Part 2: Install the boot loader properly. Workaround for firmware->grub->kernel
DEVICE=$(echo '/dev/'$(ls -l /dev/disk/by-path | grep pci-0000:21:00.0-
scsi-0:2:0:0 | grep -E -v '[0-9]$\ ' | cut -d/ -f3))
/sbin/grub-install $DEVICE
# Part 3: Format HANA_DISK with XFS options for performance again, xfsprogs
needed
mount /hana/disk 2>&1 >> /tmp/xfs.log
DEVICE=$(mount | grep \ /hana\ /disk | cut -d " " -f1)
umount $DEVICE
OLD_UUID=$(blkid $DEVICE | cut -d= -f3 | sed 's/\\"//g' | cut -d" " -f1)
/sbin/mkfs.xfs -f -d sunit=2048,swidth=14336,agcount=24 -L HANA_DISK $DEVICE
2>&1 >> /tmp/xfs.log
NEW_UUID=$(blkid $DEVICE | cut -d= -f3 | sed 's/\\"//g' | cut -d" " -f1)
# Change FSTAB options for this partition
sed -i "s/$OLD_UUID/$NEW_UUID/g" /etc/fstab
mount /hana/disk 2>&1 >> /tmp/xfs.log
mkdir -p /hana/disk/shared 2>&1 >> /tmp/xfs.log
mkdir -p /hana/disk/data 2>&1 >> /tmp/xfs.log
ln -sf /hana/disk/shared /hana/shared 2>&1 >> /tmp/xfs.log
ln -sf /hana/disk/data /hana/data 2>&1 >> /tmp/xfs.log
TEMP=$(mktemp)
cat /etc/fstab | sed 's/LABEL=HANA_BACKUP/#LABEL=HANA_BACKUP/g' > $TEMP
cp -f $TEMP /etc/fstab
rm ${TEMP}
%end

# ***** Post-Installation 2: Custom code for the OS configuration and SAP
HANA installation *****
%post --interpreter /bin/bash
chkconfig kdump off
chkconfig rhsmcertd off
chkconfig NetworkManager off
chkconfig network on
chkconfig ntpd on
echo timehost.example.com >> /etc/ntp/step-tickers
chkconfig ntpdate on
%end

# ***** Post-Installation 3: Install the repos required. We do not have a
Satellite Server here. *****
%post --interpreter /bin/bash
# Set the repositories to point to the PXE-server
# Use the ones from Red Hat, but cleanup first
yum clean all
rm -f /etc/yum.repos.d/*.repo
# Part 1: The machine where the RPMs are stored. !!!!!!!!!!! To be modified by
OEM. !!!!!!!!!!!
SERVER=192.168.0.100
# Part 2: Install the repo files
cat > /etc/yum.repos.d/rhel.repo << EOF
[rhel]
name=Red Hat Enterprise Linux $releasever - $basearch
baseurl=ftp://${SERVER}/pub/rhel6/dvd
enabled=1
gpgcheck=1
gpgkey=file:///etc/pki/rpm-gpg/RPM-GPG-KEY-redhat-release
[rhel-sfs]
name=Red Hat Enterprise Linux - Scalable File Systems
baseurl=ftp://${SERVER}/pub/rhel6/sfs

```

```

enabled=1
gpgcheck=1
gpgkey=file:///etc/pki/rpm-gpg/RPM-GPG-KEY-redhat-release
EOF
# The SAP-Repository, which is needed for SAP HANA
cat > /etc/yum.repos.d/rhel-sap.repo << EOF
[sap]
name=Red Hat Enterprise Linux for SAP
baseurl=ftp://${SERVER}/pub/rhel6/sap
enabled=1
gpgcheck=0
EOF
%end
# ***** Post-Installation 4: Create the resolv.conf file *****
%post --interpreter /bin/bash
# Part 1: Declaration of the network parameters. !!!!!!!!!!! To be modified by
OEM. !!!!!!!!!!!
DOMAINS=example.com,sap.corp
DNS1=192.168.1.100
DNS2=192.168.1.200
# Part 2: Fill the file /etc/resolv.conf
cat > /etc/resolv.conf << EOF
search ${DOMAINS}
nameserver ${DNS1}
nameserver ${DNS2}
EOF
%end
# ***** Post-Installation 5: Create the network devices and the UDEV rules
*****
# Part 1: Declaration of the network parameters. !!!!!!!!!!! To be modified by
OEM. !!!!!!!!!!!
%post --interpreter /bin/bash
BPROTO[0]="static"
IPADDR[0]=192.168.0.101
PREFIX[0]=22
HWADDR[0]=00:25:5c:d4:fc:0c
BPROTO[1]="none"
IPADDR[1]=
PREFIX[1]=24
HWADDR[1]=00:25:5c:d4:fc:0d
BPROTO[2]="none"
IPADDR[2]=
PREFIX[2]=24
HWADDR[2]=00:25:5c:d4:fc:02
BPROTO[3]="none"
IPADDR[3]=
PREFIX[3]=24
HWADDR[3]=00:25:5c:d4:fc:03
HOSTNAME=oemhanar07
GATEWAY=192.168.0.1
DOMAIN=example.com,sap.corp
DNS1=192.168.1.100
DNS2=192.168.1.200
# Part 2: Save the persistent udev rules
mv /etc/udev/rules.d/70-persistent-net.rules /root
# Part 3: Fill the network configuration files and the persistent udev rules
i=0;
max=${#IPADDR[@]}
while [ $i -lt $max ]; do
    if [ "${BPROTO[$i]}" == "none" ]
    then
        bootstart="no";
    else
        bootstart="yes";
    fi
    # Define the given static interfaces
    cat > /etc/sysconfig/network-scripts/ifcfg-eth${i} << EOF
DEVICE=eth${i}

```

```

BOOTPROTO=${BPROTO[${i}]}
IPADDR=${IPADDR[${i}]}
PREFIX=${PREFIX[${i}]}
HWADDR=${HWADDR[${i}]}
ONBOOT=${bootstart}
TYPE=Ethernet
EOF
    echo "# Network card ${i}" >> /etc/udev/rules.d/70-persistent-net.rules
    echo "SUBSYSTEM==\"net\", ACTION==\"add\", DRIVERS==\"?*\", ATTR{address}==\"${HWADDR[${i}]}\", ATTR{type}==\"1\", KERNEL==\"eth*\", NAME=\"eth${i}\""
>> /etc/udev/rules.d/70-persistent-net.rules
    echo "" >> /etc/udev/rules.d/70-persistent-net.rules
    i=$((expr ${i} + 1));
done
cp /etc/udev/rules.d/70-persistent-net.rules /root
if [ ${max} -eq 0 ]; then
    # Define a default dhcp network interface
    cat > /etc/sysconfig/network-scripts/ifcfg-eth0 <<EOF
DEVICE=eth0
BOOTPROTO=dhcp
ONBOOT=yes
TYPE=Ethernet
EOF
fi
# Part 4: Define the hostname. This is just for testing and should be resolved
using DNS.
hostname $(echo ${HOSTNAME})
cat > /etc/sysconfig/network <<EOF
NETWORKING=yes
HOSTNAME=${HOSTNAME}
GATEWAY=${GATEWAY}
DOMAIN=${DOMAIN}
DNS1=${DNS1}
DNS2=${DNS2}
EOF
# Part 5: Also, extend the file /etc/hosts. Without the extension, the SAP HANA
installer will lock up. !!!!!!!!!!! The index of IPADDR[4] to be modified by
OEM. !!!!!!!!!!!
DOMEXT=$(echo ${DOMAIN} | cut -d, -f1)
cat >> /etc/hosts <<EOF
${IPADDR}      ${HOSTNAME}.${DOMEXT}      ${HOSTNAME}
EOF
%end
# ***** Post-Installation 6: Configuration of the network time protocol
(NTP) *****
%post --interpreter /bin/bash
# Part 1: Set the NTP server. !!!!!!!!!!! To be modified by OEM. !!!!!!!!!!!
NTP=ntp.example.com
# Part 2: Write the file /etc/ntp.conf
cat > /etc/ntp.conf << EOF
driftfile /var/lib/ntp/drift
restrict default kod nomodify notrap nopeer noquery
restrict -6 default kod nomodify notrap nopeer noquery
restrict 127.0.0.1
restrict -6 ::1
server ${NTP}
includefile /etc/ntp/crypto/pw
keys /etc/ntp/keys
EOF
# Part 3: Set the time manually
service ntpd stop 2>/dev/null 1>&2
ntpdate ${NTP}
service ntpd start
%end
# ***** Post-Installation 7: Create a symbolic link because hdbnsutil
crashes otherwise *****
%post --interpreter /bin/bash
ln -s /usr/lib64/libssl.so.1.0.1e /usr/lib64/libssl.so.1.0.1

```



```

%end
# 20140430 SAP HANA off
# ***** Post-Installation 8: Install the SAP HANA database software
*****
%post --interpreter /bin/bash
# Part 1: Set the installation server. !!!!!!!!!!! To be modified by
OEM. !!!!!!!!!!!
SERVER=192.168.0.100
# Part 2: Copy the archive and the password file
cd /tmp
wget ftp://${SERVER}/pub/hana/HanaInstall_WS.29.04.2014.tar
cd /root
wget ftp://${SERVER}/pub/hana/password.xml
chmod 400 /root/password.xml
cd /tmp
tar xvf HanaInstall_WS.29.04.2014.tar
cd <installation medium>/DATA_UNITS/HDB_LCM_LINUX_X86_64/
# Part 4: SAP HANA Installation
# The prototype will not need the following link anymore
# Install SAP HANA. !!!!!!!!!!! The instance (option --sid) and the password.xml
file to be modified by OEM !!!!!!!!!!!
LD_PRELOAD=/opt/rh/SAP/lib64/compat-sap-c++.so \
cat /root/password.xml | <installation medium>/DATA_UNITS/HDB_LCM_LINUX_X86_64/
hdblcm --read_password_from_stdin=xml --sid=ANA \
--number=00 --sapmnt=/hana/shared --datapath=/hana/data --logpath=/hana/log --
shell=/bin/bash \
--hostname=$(hostname) -b --system_usage=test --autostart=1 --components=server
--system_usage=test \
--timezone=CET
# Part 5: Clean up
#rm -f /root/password.xml
#rm -fr <installation medium>/DATA_UNITS/HDB_LCM_LINUX_X86_64/
#rm -f /tmp/HanaInstall_WS.29.04.2014.tar
%end
# ***** Post-Installation 10: Modify /etc/sysctl.conf according to the
recomondations of SAP *****
# Part 1: Insert all parameters recommended by SAP and observed under SLES if
they do not already exist
%post --interpreter /bin/bash
KernelParamFile=/etc/sysctl.conf
declare -a params=(net.ipv{4,6}.neigh.default.gc_thresh{1,2,3} kernel.
{shmmni,sem})
for parm in "${params[@]"; do
    if $(grep -qv $parm $KernelParamFile); then
        case $parm in
            net.ipv4.neigh.default.gc_thresh1)
                echo "$parm = 256" >> $KernelParamFile
                ;;
            net.ipv4.neigh.default.gc_thresh2)
                echo "$parm = 1024" >> $KernelParamFile
                ;;
            net.ipv4.neigh.default.gc_thresh3)
                echo "$parm = 4096" >> $KernelParamFile
                ;;
            net.ipv6.neigh.default.gc_thresh1)
                echo "$parm = 256" >> $KernelParamFile
                ;;
            net.ipv6.neigh.default.gc_thresh2)
                echo "$parm = 1024" >> $KernelParamFile
                ;;
            net.ipv6.neigh.default.gc_thresh3)
                echo "$parm = 4096" >> $KernelParamFile
                ;;
            kernel.shmmni)
                echo "$parm = 65536" >> $KernelParamFile
                ;;
            kernel.sem)
                echo "$parm = 1250 256000 100 8192" >> $KernelParamFile

```

```

;;
    esac
fi
done
# Part 2: Delete variables not known to RHEL 6.5. This must be revised when new
releases are published
declare -a errors=(net.bridge.bridge-nf-call-{ip6tables,iptables,arptables}
net.ipv6.neigh.default.gc_thresh{1,2,3})
for parm in "${errors[@]}"; do
    if $(cat $KernelParamFile | grep -v \# $KernelParamFile | grep -q $parm
$KernelParamFile > /dev/null); then
        sed -i /$parm/d $KernelParamFile
    fi
done
%end

```

4.9 Appendix I – Configure the Firewall

To configure the firewall on a RHEL for SAP HANA system, you can use the `system-config-firewall` tool (you will need an X11 System to display the GUI version, or you can use the `-tui` option for a pseudo-graphical interface in the shell) or you can modify the firewall setup directly with `iptables` or indirectly by applying new rules to the file `/etc/sysconfig/iptables`.

In the following description, we will use the direct method, with the `iptables` command. At the time of writing, this step has not yet been included in the kickstart file.

4.9.1 Calculation of the Ports Used

SAP HANA uses several ports for different purposes.

Most of these ports have to be calculated based on the instance number. For the following ports, a database with the instance **99** is used to illustrate the calculation.

Table 9:

Schema	Calculated port	Description
3xx09	39909	Administration port for SAP HANA
1128 – 1129	1128-1129	SAP HANA Studio
5xx13 - 5xx14	59913 - 59914	
43xx	4399	Company Network
80xx	8099	
3xx15	39915	SAP HANA Studio + Replication
3xx17	39917	

Schema	Calculated port	Description
3xx01	39901	Primary Site for Clustering
3xx07	39907	

4.9.2 Common Networks

When creating the firewall, do not forget to ask the customer which different networks s/he will need the services in. You can use the list of usual networks from the table below as a basis. These networks are also used in the sample kickstart script.

Table 10:

Network	Purpose	Remark
Administration	Administer the SAP HANA setup	Only administrators should have access
Client Network	Work with the database	Normal users have access
Replication Network	Replication Services and other instances	Network for instances that SAP HANA is automatically replicated to
Primary Network	Cluster communication between nodes	Used for building clusters
Company Network	Network to access the SAP HANA database from inside the company	

4.9.3 Write the Firewall

For every network you have to add the rules with the calculated port number.

If you use `iptables` as in the example below, make sure that you insert the rule after a rule which accepts all packages for the states `RELATED` & `ESTABLISHED`. The SAP HANA instance number used in this example is **99**. Make sure that you replace this with your instance number.

1. Start adding the rules for the administration network:

```
# /sbin/iptables -I INPUT 2 -s <ADMINISTRATION> -p tcp -m state \
--state NEW --dport 39909 -j ACCEPT
```

2. Now open the network with the SAP HANA studio clients. As you can see, the last two rules are there for the replication services. SAP HANA Studio also needs access to these ports.

```
# /sbin/iptables -I INPUT 2 -s <CLIENT-NETWORK> -p tcp -m state \
--state NEW --dport 1128 -j ACCEPT
# /sbin/iptables -I INPUT 2 -s <CLIENT-NETWORK> -p tcp -m state \
--state NEW --dport 1129 -j ACCEPT
# /sbin/iptables -I INPUT 2 -s <CLIENT-NETWORK> -p tcp -m state \
--state NEW --dport 59913 -j ACCEPT
# /sbin/iptables -I INPUT 2 -s <CLIENT-NETWORK> -p tcp -m state \
--state NEW --dport 59914 -j ACCEPT
# /sbin/iptables -I INPUT 2 -s <CLIENT-NETWORK> -p tcp -m state \
```

```
--state NEW --dport 39917 -j ACCEPT
# /sbin/iptables -I INPUT 2 -s <CLIENT-NETWORK> -p tcp -m state \
--state NEW --dport 39915 -j ACCEPT
# /sbin/iptables -I INPUT 2 -s <CLIENT-NETWORK> -p tcp -m state \
--state NEW --dport 1128 -j ACCEPT
# /sbin/iptables -I INPUT 2 -s <CLIENT-NETWORK> -p tcp -m state \
--state NEW --dport 1129 -j ACCEPT
# /sbin/iptables -I INPUT 2 -s <CLIENT-NETWORK> -p tcp -m state \
--state NEW --dport 59913 -j ACCEPT
# /sbin/iptables -I INPUT 2 -s <CLIENT-NETWORK> -p tcp -m state \
--state NEW --dport 59914 -j ACCEPT
# /sbin/iptables -I INPUT 2 -s <CLIENT-NETWORK> -p tcp -m state \
--state NEW --dport 39917 -j ACCEPT
# /sbin/iptables -I INPUT 2 -s <CLIENT-NETWORK> -p tcp -m state \
--state NEW --dport 39915 -j ACCEPT
```

- Now add the rules for the public company network. This is for remote devices others than the SAP HANA Studio clients, which need access to SAP HANA.

```
# /sbin/iptables -I INPUT 2 <COMPANY-NETWORK> -p tcp -m state \ --state
NEW --dport 8099 -j ACCEPT
# /sbin/iptables -I INPUT 2 -s <COMPANY-NETWORK> -p tcp -m state \
--state NEW --dport 4399 -j ACCEPT
```

- Then add the rules for the replication services.

```
# /sbin/iptables -I INPUT 2 -s <REPLICATION> -p tcp -m state \ --state
NEW --dport 39915 -j ACCEPT
# /sbin/iptables -I INPUT 2 -s <REPLICATION> -p tcp -m state \ --state
NEW --dport 3${hana_instance}17 -j ACCEPT
```

- Finally (if you are working in a clustered Environment) you have to add the rule for cluster synchronization.

```
# /sbin/iptables -I INPUT 2 -s <PRIMARY-NETWORK> -p tcp -m state \
--state NEW --dport 39901-39907 -j ACCEPT
```

4.10 Appendix J - Installation in a Virtual Machine (VMware)

SAP HANA in combination with RHEL 6.5 for SAP HANA can be installed in a virtual machine operated by a VMware Hypervisor.

The following prerequisites must be fulfilled:

- The underlying hardware must be certified by SAP's ICC for SAP HANA.
- Do not use memory compression techniques like KSM.
- The maximum memory reserved for the virtual machines should not exceed 90% of the physical memory of the hypervisor.
- SAP HANA needs the full instruction set of the host CPU(s). Adjust the settings for the VM accordingly.
- RHEL 6.5 for SAP HANA already includes the paravirtualization drivers for VMware. For monitoring and system management purposes, VMware Tools must be installed and running as well.
- To obtain the best manageability, use the paravirtualization drivers included in RHEL 6.5 for SAP HANA instead of PCI pass through (VT-d).
- For performance reasons, the SAP HANA file systems should reside on separate VMDK files.
- For tuning the operating environment, see *Prepare the Host*.

For more information, see Related Information.

Related Information

[SAP Note 1995460 - Single SAP HANA VM on VMware vSphere in production](#)

[SAP Note 2024433 - Multiple SAP HANA VMs on VMware vSphere in production \(controlled availability\)](#)

[VMware Best Practices on SAP HANA](#)

[Prepare the Host \[page 4\]](#)

4.11 Appendix K - Important SAP Notes

Read the following SAP Notes. These SAP Notes contain the latest information about the installation.

SAP Note Number	Title
1514967	SAP HANA: Central Note
2075266	SAP HANA Platform SPS 09 Release Note
2009879	SAP HANA Guidelines for Red Hat Enterprise Linux (RHEL)
2013638	SAP HANA DB: Recommended OS settings for RHEL 6.5
2001528	Linux: SAP HANA Database SPS 08 revision 80 (or higher) on RHEL 6 or SLES 11
1658845	Recently certified SAP HANA hardware/OS not recognized
1984700	HANA stopped unexpectedly
2100296	read/write lock file in /tmp for shared memory synchronisation of HANA DB interprocess communication
2111143	HANA DB Crash

Note

The **automatic deletion of files in the folder** `/tmp` which are older than 10 days needs to be switched of. For more information, see the following SAP Notes:

- [1984700](#) - HANA stopped unexpectedly
- [2100296](#) - read/write lock file in /tmp for shared memory synchronisation of HANA DB interprocess communication
- [2111143](#) - HANA DB Crash

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